The result of use case of P4
and
New use case of P4

1. Introduction
   1. About NTT group
   2. Market of Japan

2. The result of use case of P4
   1. Our network
   2. Expectation of P4 switch
   3. Use case and the Results

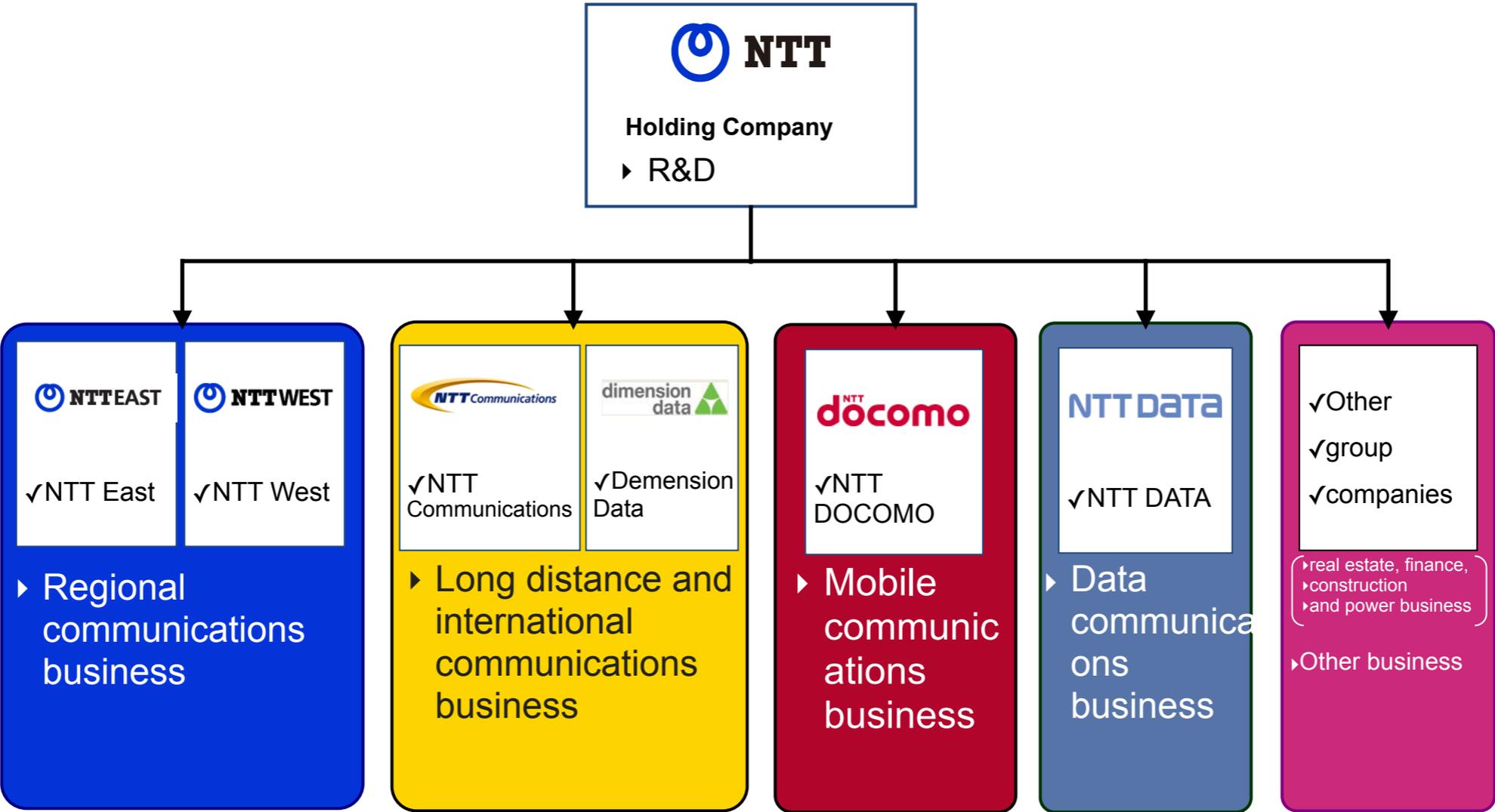# 3. The new use case of P4
   1. Current network demands
   2. Expectation of new network
   3. The new use case of P4
   4. Conclusion

Introduction

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About NTT Group

NTT(as a holding company) and several operational companies.

- NTT ・・・ Group management and basic research
- NTT East/West ・・・ Regional communications business
- NTT Communication ・・・ Long distance and international communications business
- NTT DoCoMo ・・・ Mobile communications business

NTT

Holding Company
‣ R&D

NTT EAST / NTT WEST	NTT Communications / dimension data	docomo	NTT DATA	Other group companies
✓NTT East ✓NTT West	✓NTT Communications ✓Demension Data	✓NTT DOCOMO	✓NTT DATA	✓Other ✓group ✓companies
‣ Regional communications business	‣ Long distance and international communications business	‣ Mobile communications business	‣ Data communications business	‣real estate, finance, ‣construction ‣and power business ‣Other business

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NTT EAST/WEST is providing "Regional fixed access service(last mile)".

FTTH share in Japan ※1
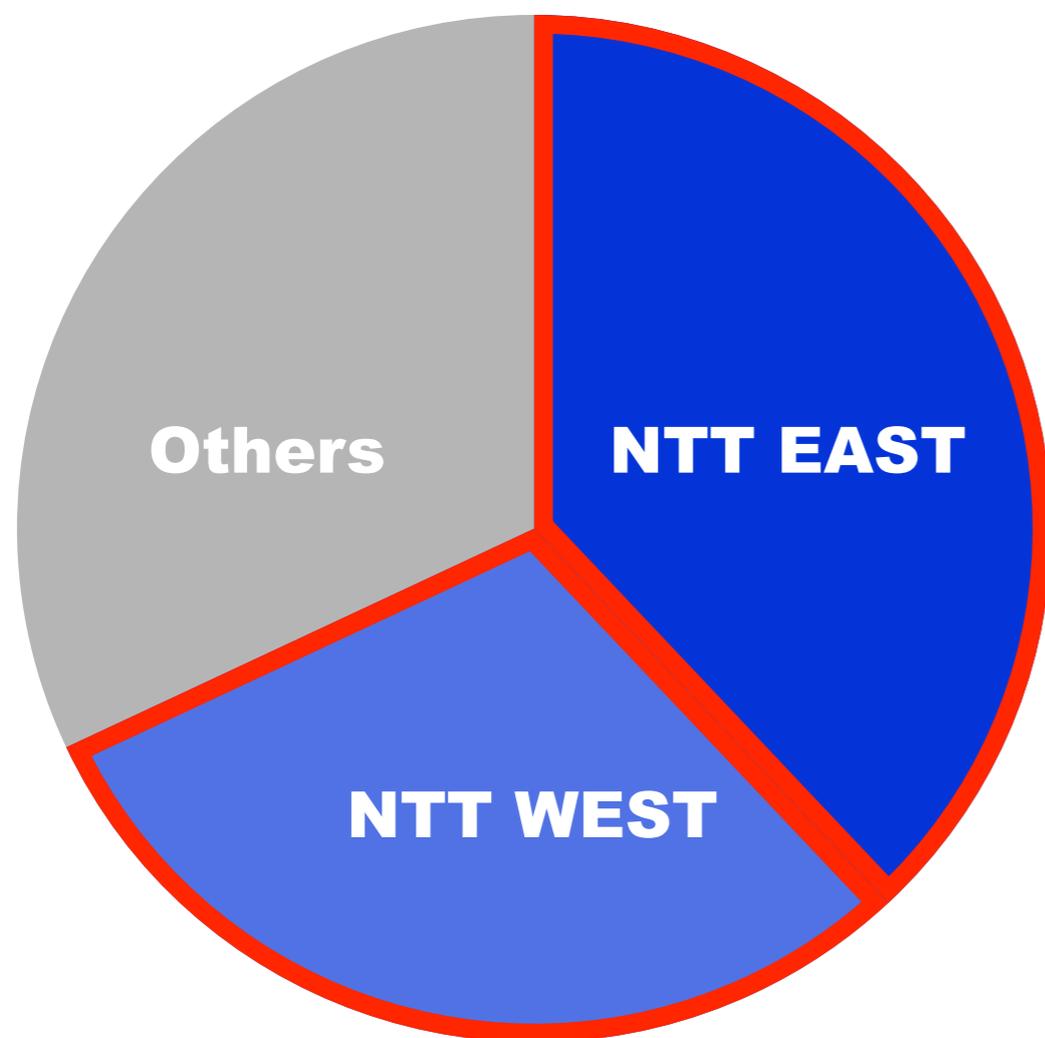
The total of NTT EAST & WEST FTTH share is almost **70%**.

20.53 million subscriptions※2

※1:Ministry of internal Affairs and communications, <http://www.soumu.go.jp/main_content/000628550.pdf> Edited by NTT East.   (Accessed 2019/08/19)

※2:The figures include the number of subscriptions for wholesale services providers through the use of the Hikari collaboration. (as of march 31, 2018)

The Result of Use cases of P4

Next Generation Network (NGN)

- **Provide FTTH and other services thorough NGN.**
- **Thousands of "Legacy" routers are in operation.**
- **Market, technologies and services are rapidly changing.**

■Rough sketch of NGN

Internet

ISP

IPoE

NGN Services

NGN

CPE

CPE

CPE
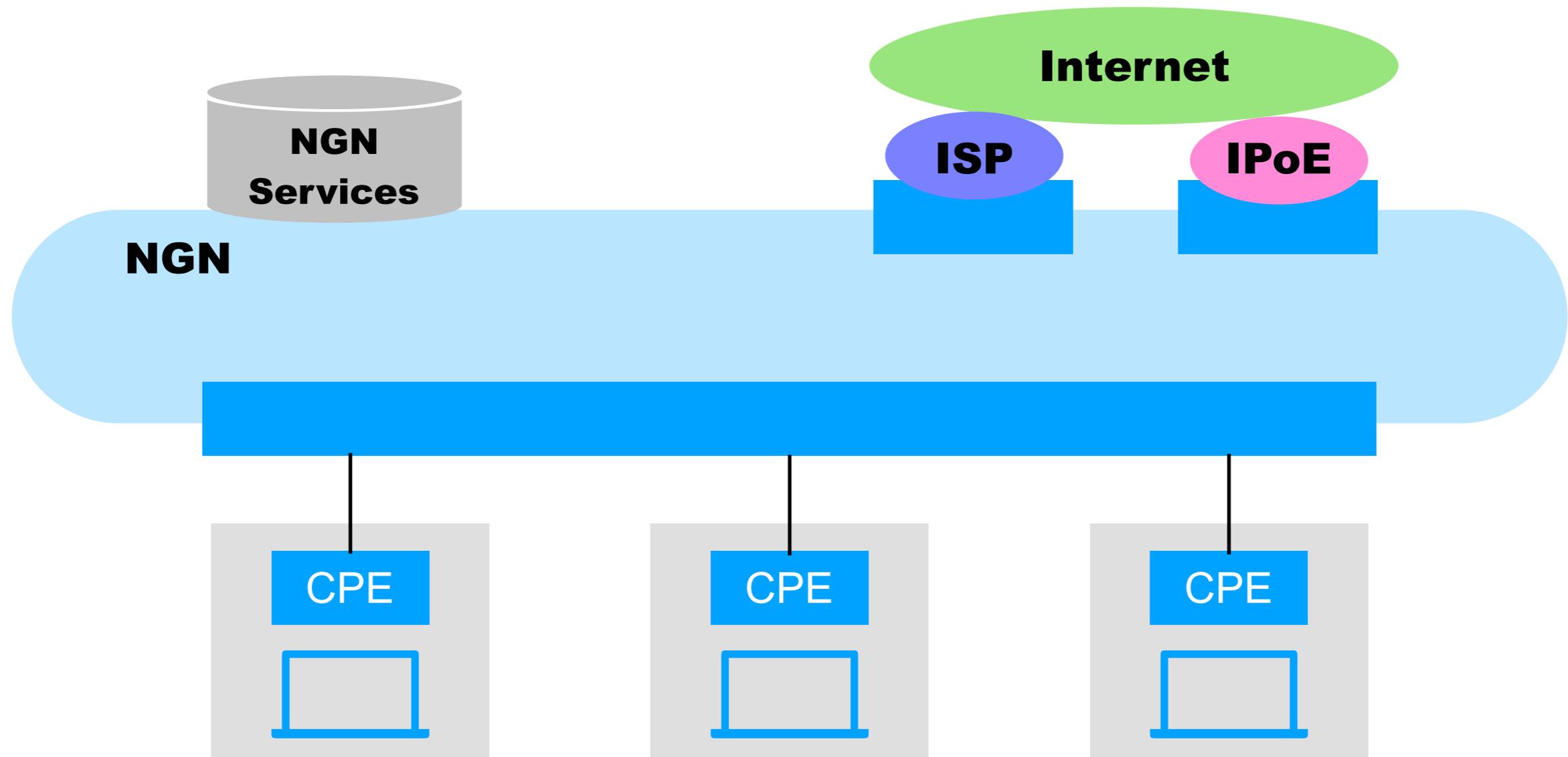
Expectation for P4 Switch

- Cost reduction is important.
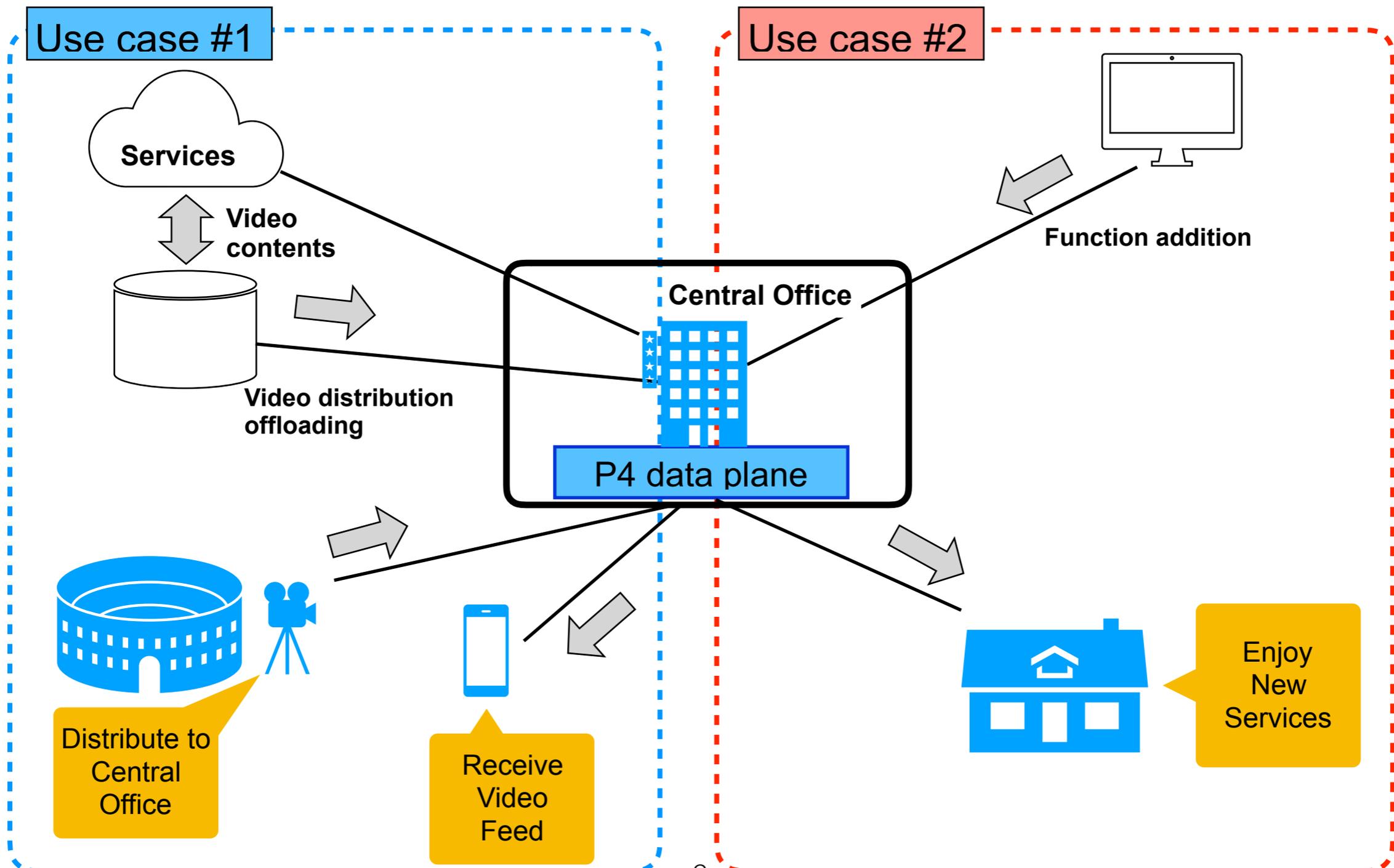- Creating New business is more important.

COST REDUCTION

NEW SERVICE

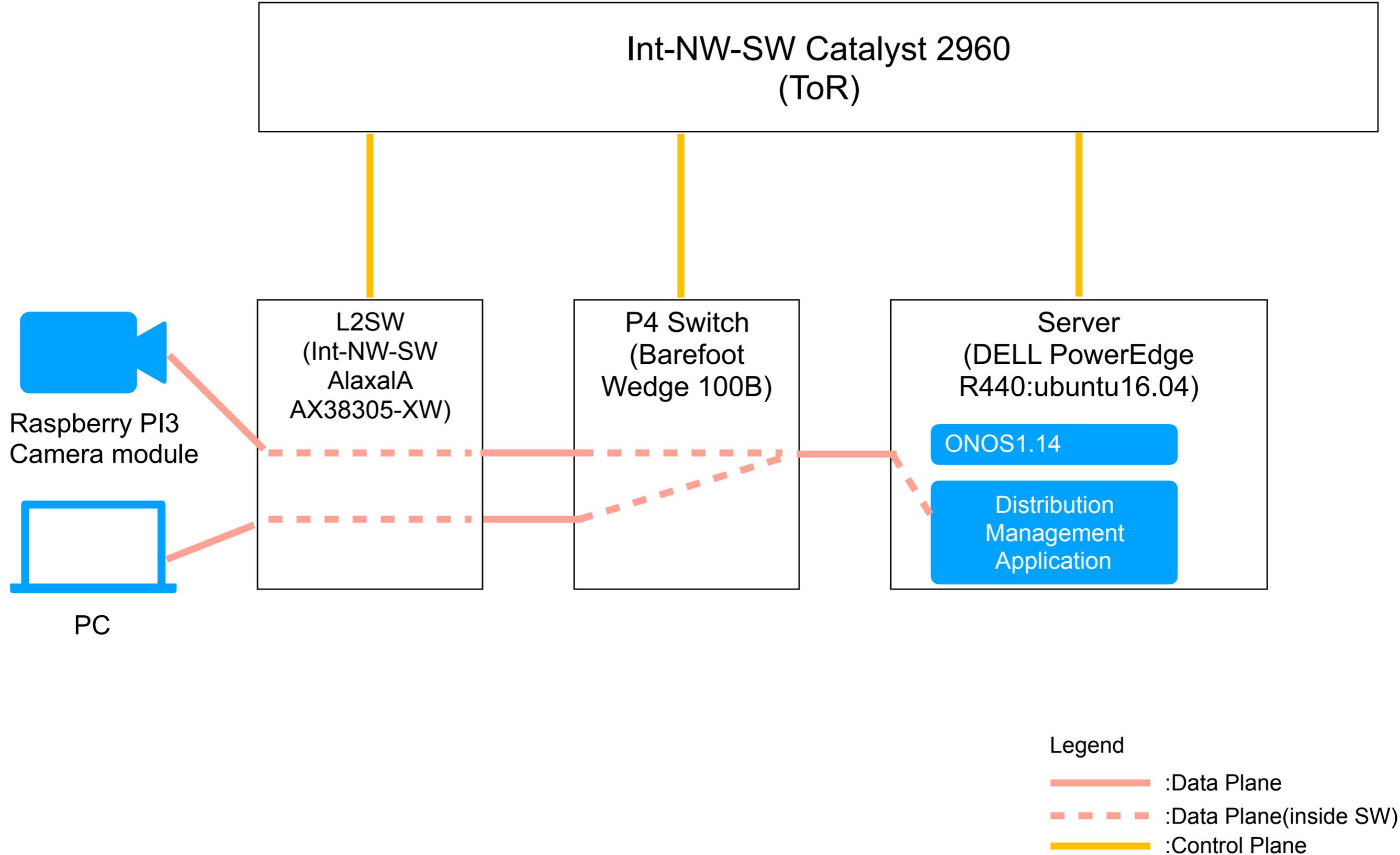# Purpose of two use cases

- **Evaluated following two use cases using P4 switches to explore the service benefits and business opportunities.**
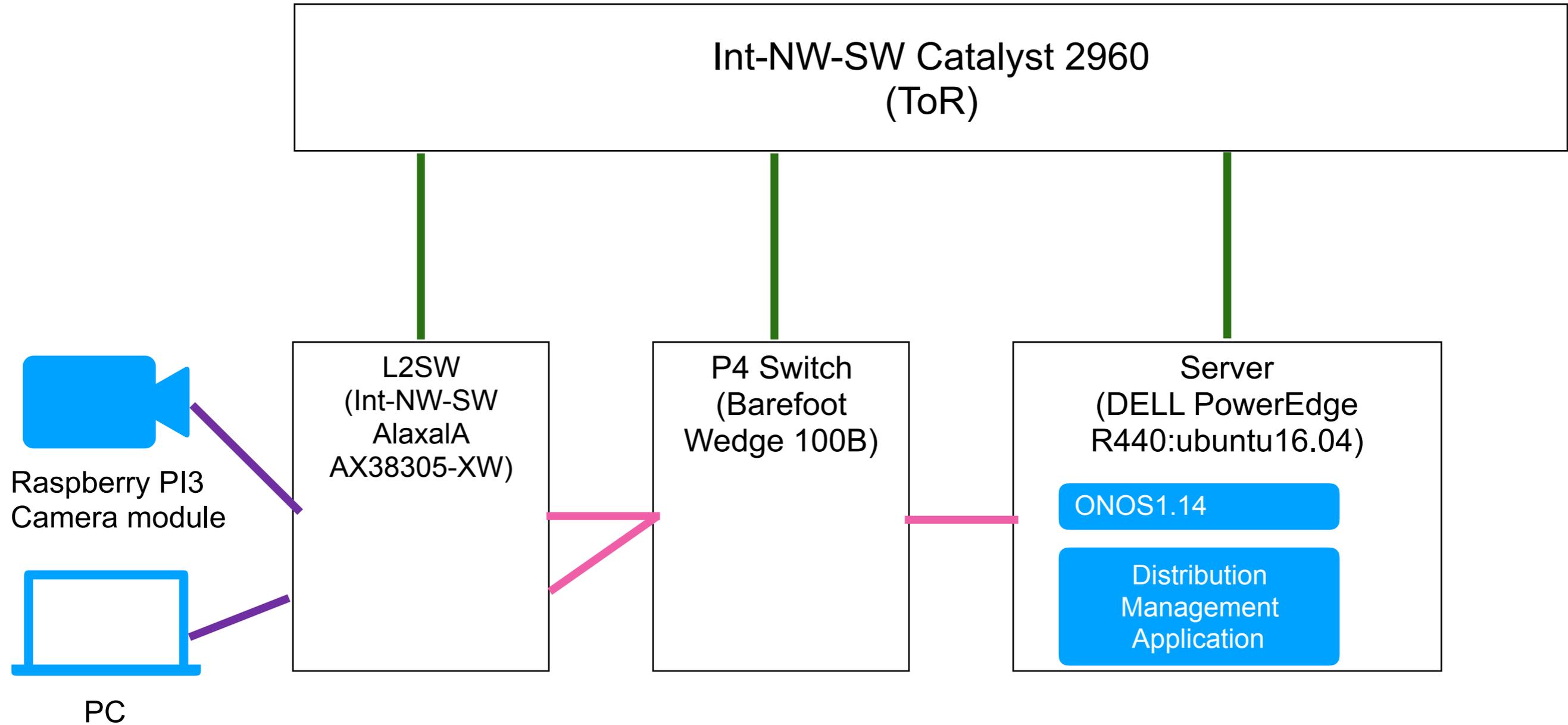 (1) Live streaming use case (#1)
  (2) Data plane feature re-programability use case (#2)

System structure

Int-NW-SW Catalyst 2960 (ToR)

L2SW (Int-NW-SW AlaxalA AX38305-XW)

P4 Switch (Barefoot Wedge 100B)

Server (DELL PowerEdge R440:ubuntu16.04)

ONOS1.14

Distribution Management Application

Raspberry PI3 Camera module

PC

Legend

— :Data Plane

--- :Data Plane(inside SW)

— :Control Plane

Hardware structure

Int-NW-SW Catalyst 2960
(ToR)

L2SW
(Int-NW-SW
AlaxalA
AX38305-XW)

P4 Switch
(Barefoot
Wedge 100B)

Server
(DELL PowerEdge
R440:ubuntu16.04)

ONOS1.14

Distribution
Management
Application

Raspberry PI3
Camera module

PC

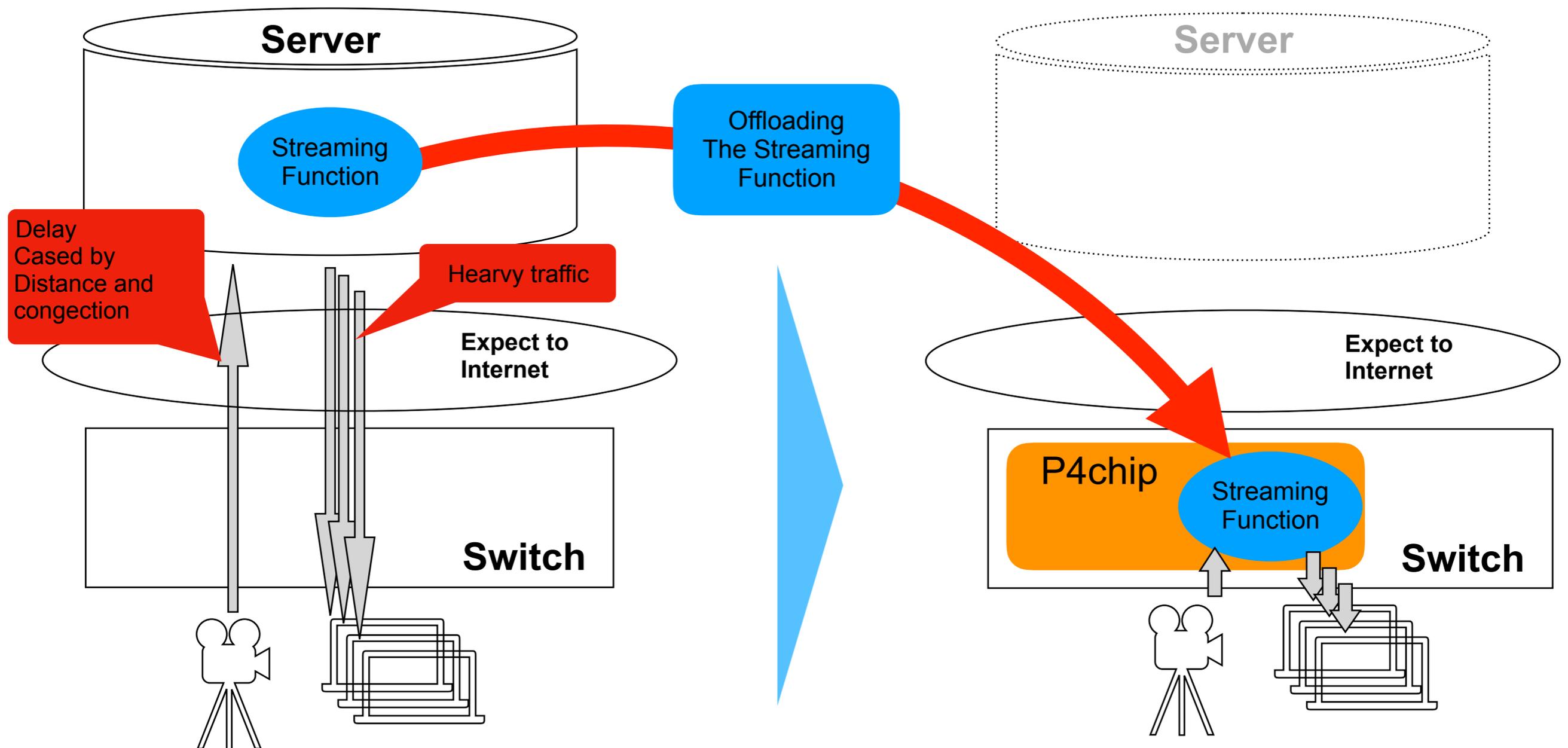Legend

: 1000Base-T(MING)

: 40G

: 1000Base-T

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The use case #1 : Live Streaming

● **Deploy and Test the streaming function on P4 switch.**
    (left fig)   Sending the Video to cloud server before streaming to users.
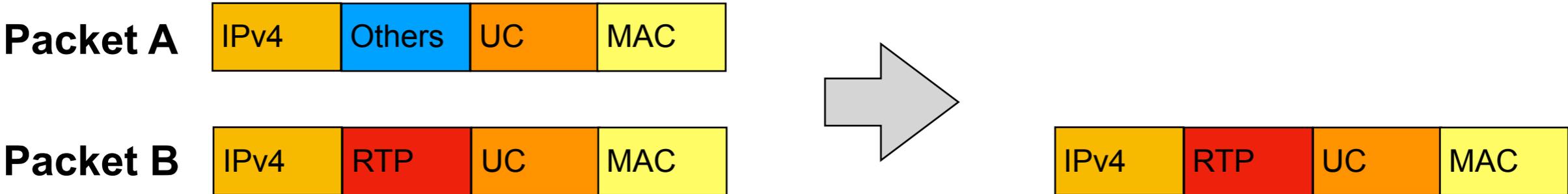   (right fig) Streaming the Video to users using P4 functions.
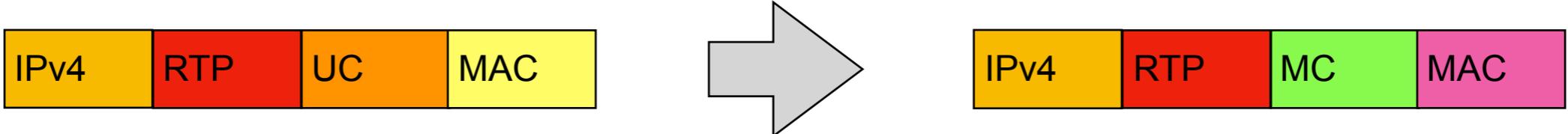
● **Simulating live streaming structures**

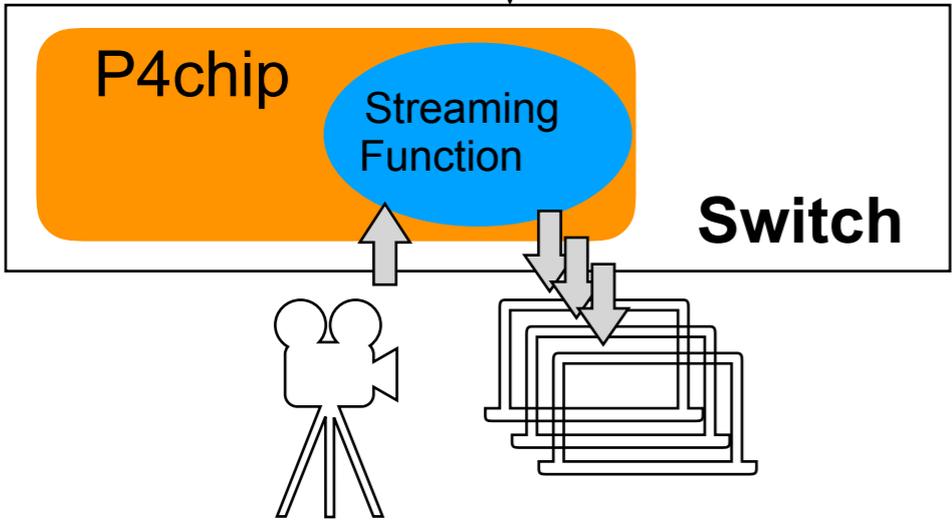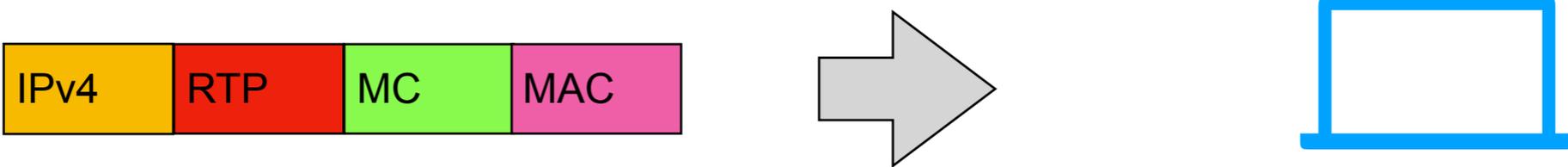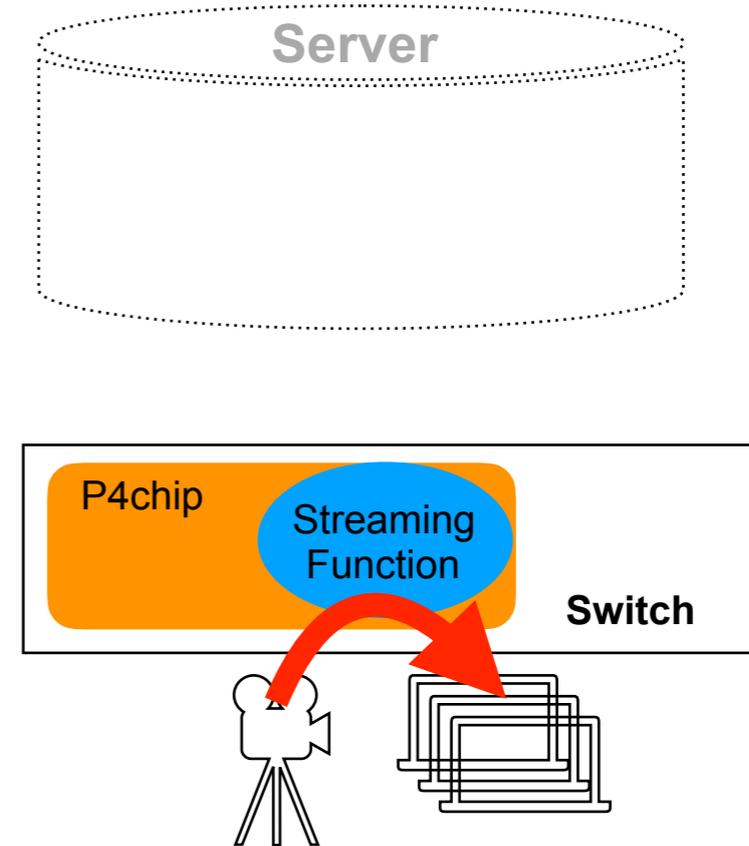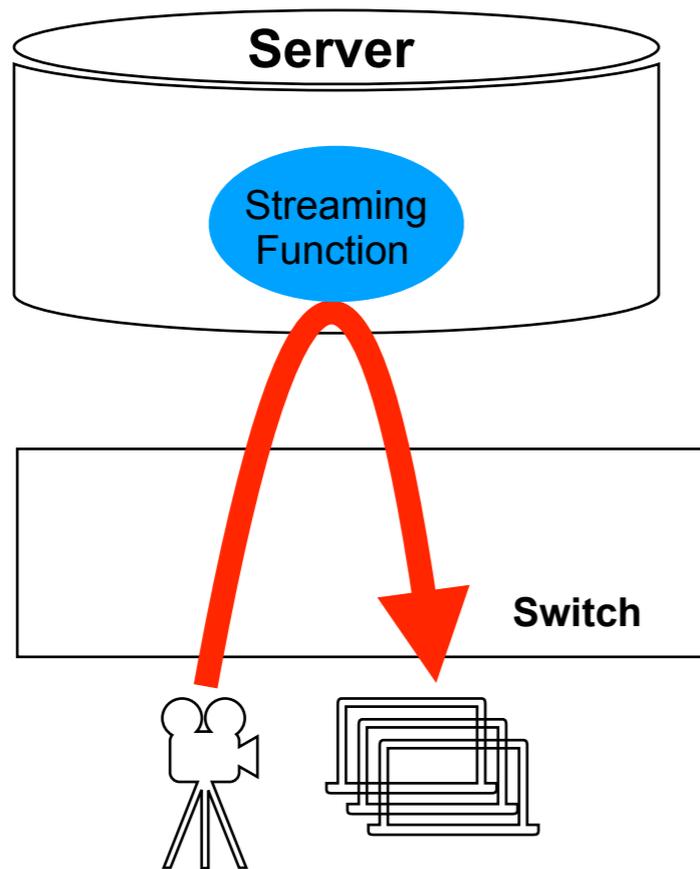# What's happening inside the P4 Switch

●STEP1 : Screen packets for RTP

Packet A | IPv4 | Others | UC | MAC |

Packet B | IPv4 | RTP | UC | MAC | ➡ | IPv4 | RTP | UC | MAC |

●STEP2 : Change IP address from Unicast to Multicast
　　　　 Change MAC address from Server to Terminal

| IPv4 | RTP | UC | MAC | ➡ | IPv4 | RTP | MC | MAC |

●STEP3 : Forward Packets

| IPv4 | RTP | MC | MAC | ➡ 💻

P4chip

Streaming Function

Switch

Results of Use case #1

●Results

✔ (1)Deployed streaming function on P4 Switch.
✔ (2)Visibly checked the function works well.
(3)Regarding the latency: there are few difference between them.
→This is natural result in this system.

Distribution from	Mean of latency※
Server	4.54 [msec]
P4 Switch	4.43 [msec]

※Mean for 5 time measurements.

The use case #2 : Switching Functions

- **Adding streaming function to P4 Switch using software processing.**
    - Switching function A to B.
- **Check the operation verification of adding new function to P4 switch.**
   - Switching functions is a basic feature of P4. But It is important for our company.

P4chip

Function A

Drop

Switch

Change Function

P4chip

Function B

Switch
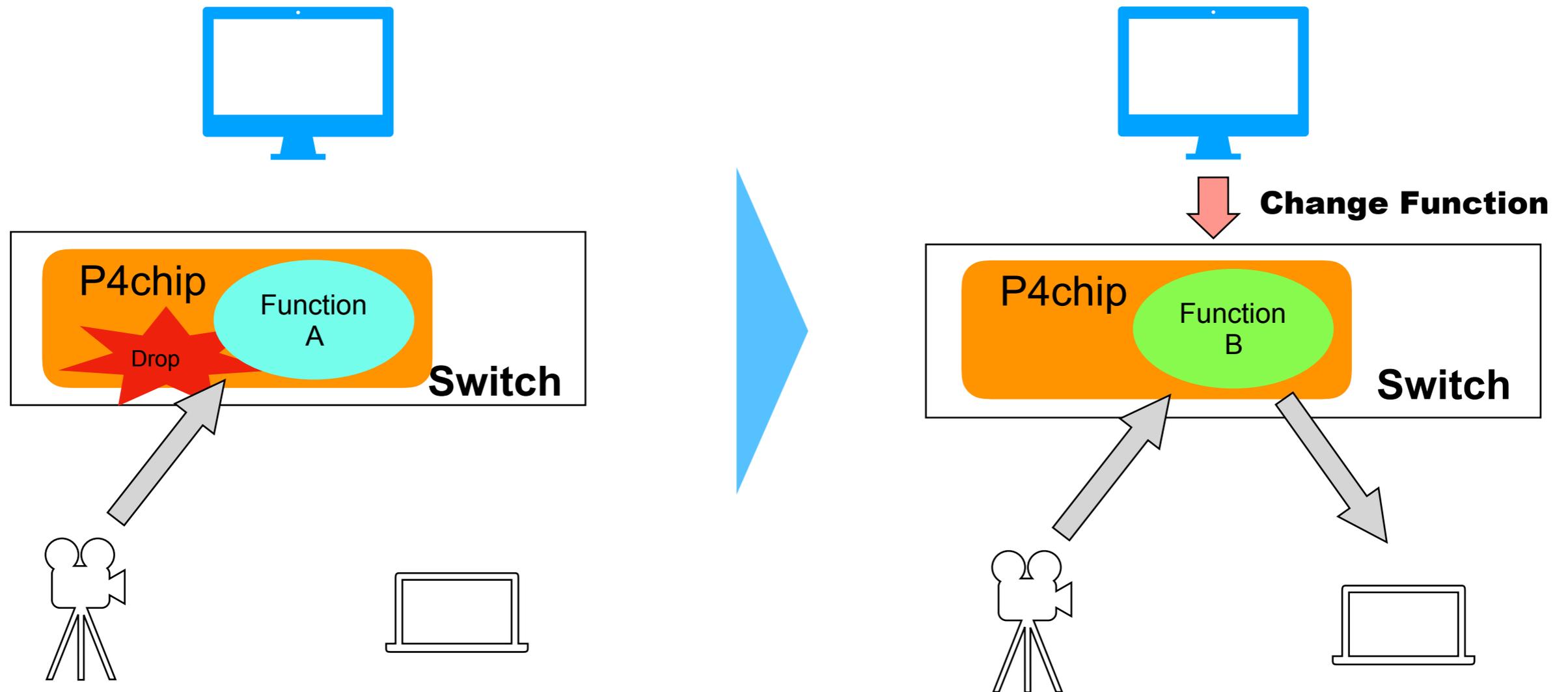
- **Results**
    - ✔ Packet loss time within 30 msec.

New Use Cases of P4

Current Network demands a lot.

- Large amount/kinds of things will be connected.
- Market, technologies and services are rapidly changing.

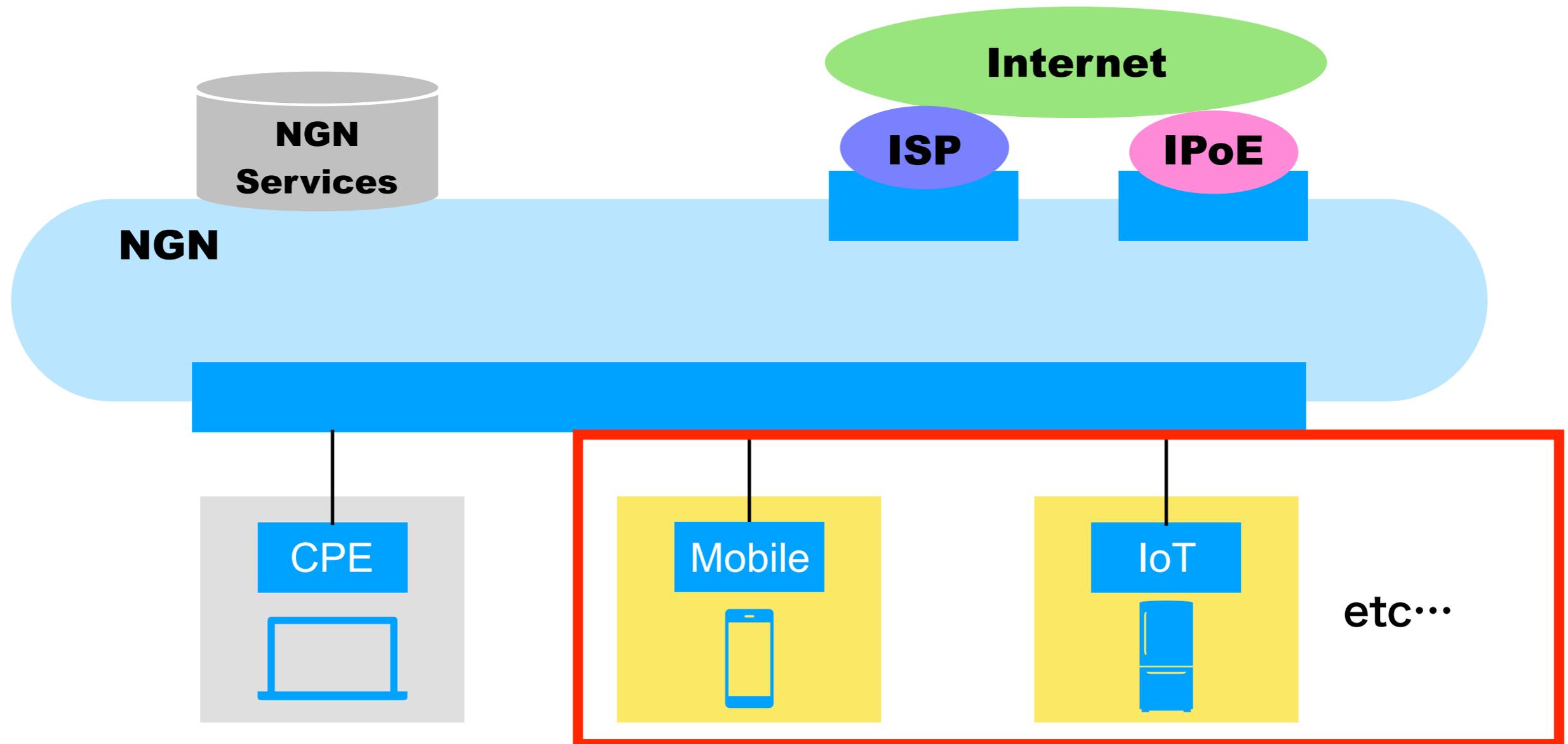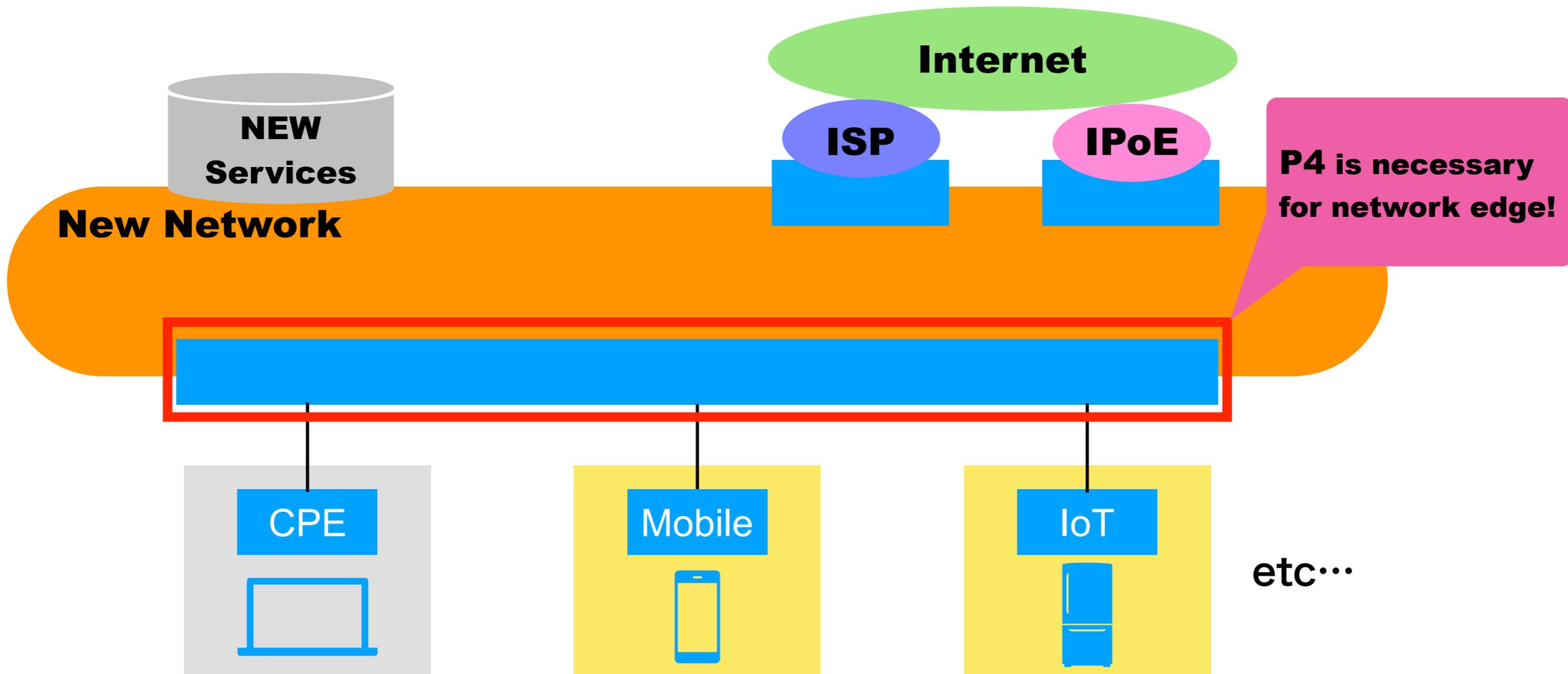NGN Services

Internet

ISP

IPoE

NGN

CPE

Mobile

IoT

etc…
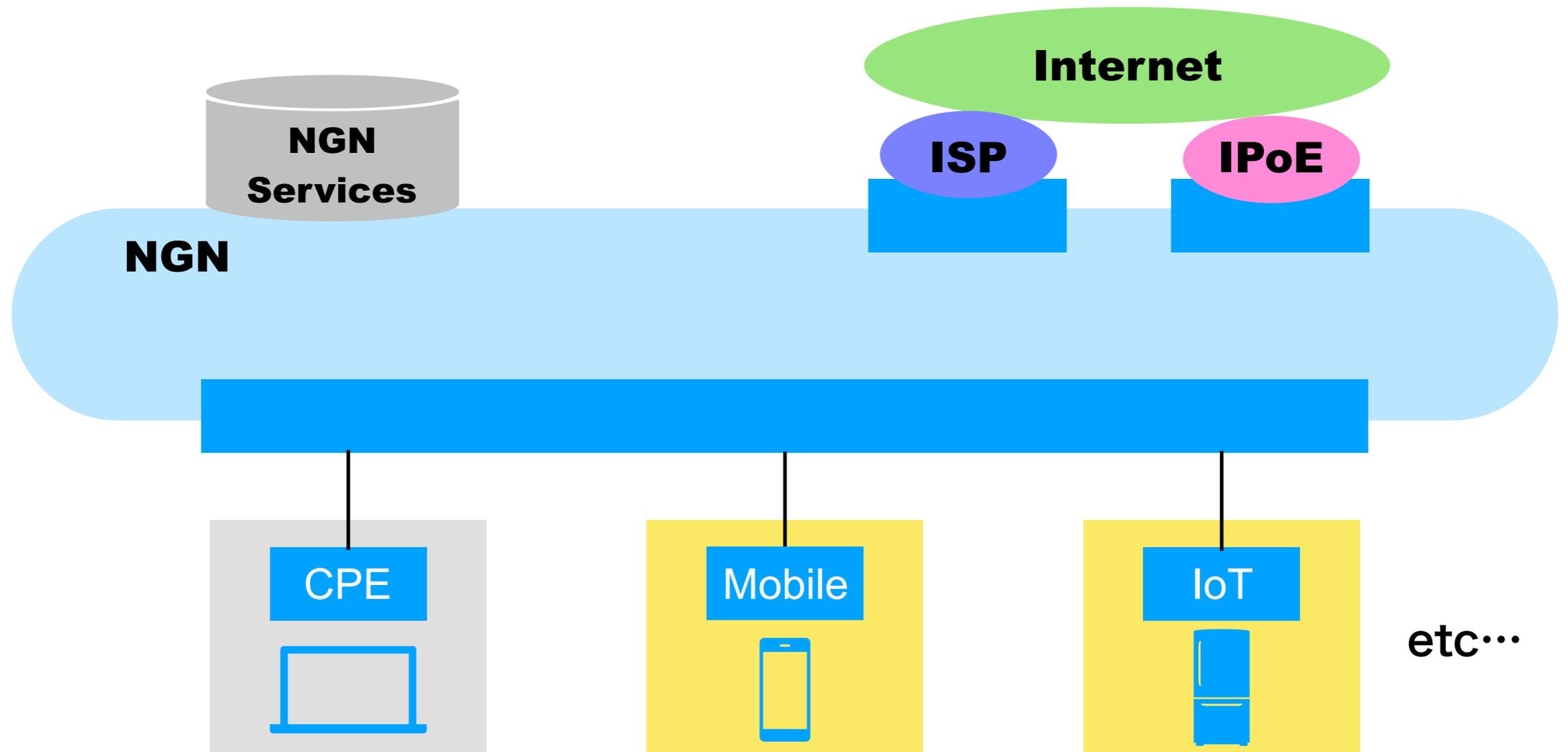
Current Network demands a lot.

- Large amount/kinds of things will be connected.
- Market, technologies and services are rapidly changing.
- Connecting new services to our network flexibly is important.
- P4 is one of the most useful technologies to handle those requirements.

Internet

ISP

IPoE

NGN Services

NGN

CPE

Mobile

IoT

etc…

Expectation for new network

- **P4 solve such problems and create new services.**
- **As one use cases of P4, we focus on Local 5G network.**

Internet

ISP

IPoE

P4 is necessary for network edge!

NEW Services

New Network

CPE

Mobile

IoT

etc…

Why Local 5G

- Low entry barriers
    Any operator can start the broadband wireless internet services.
- Market expansions
    The number of service providers are growing up significantly.
- Various capabilities
    Local 5G capabilities bring new opportunities to user's business area.
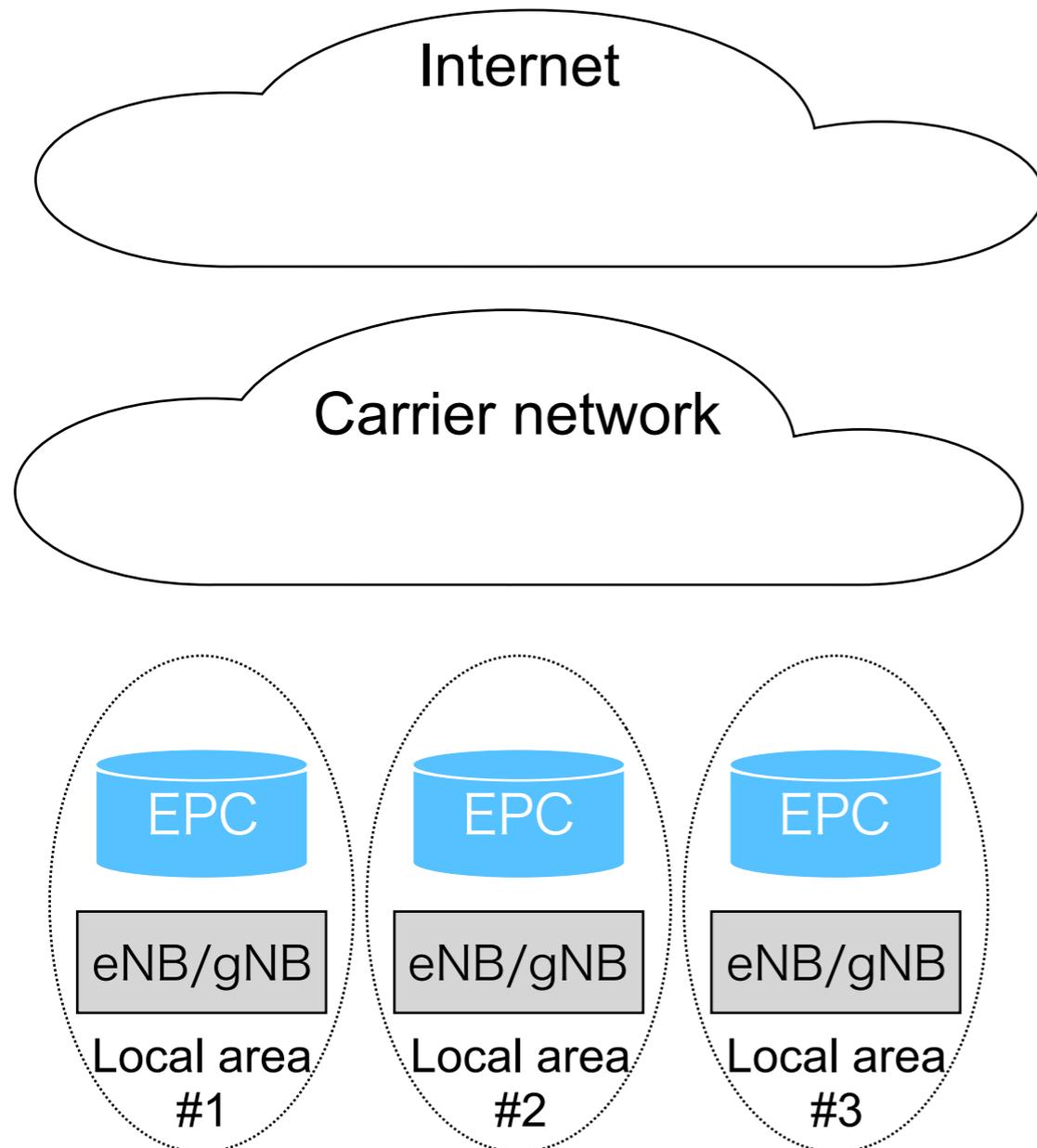
Target business area

- Live streaming service
- Government, campus, hospital network
- Rural area broadband
- Industrial automation
- Autonomous cars

Local 5G network architecture
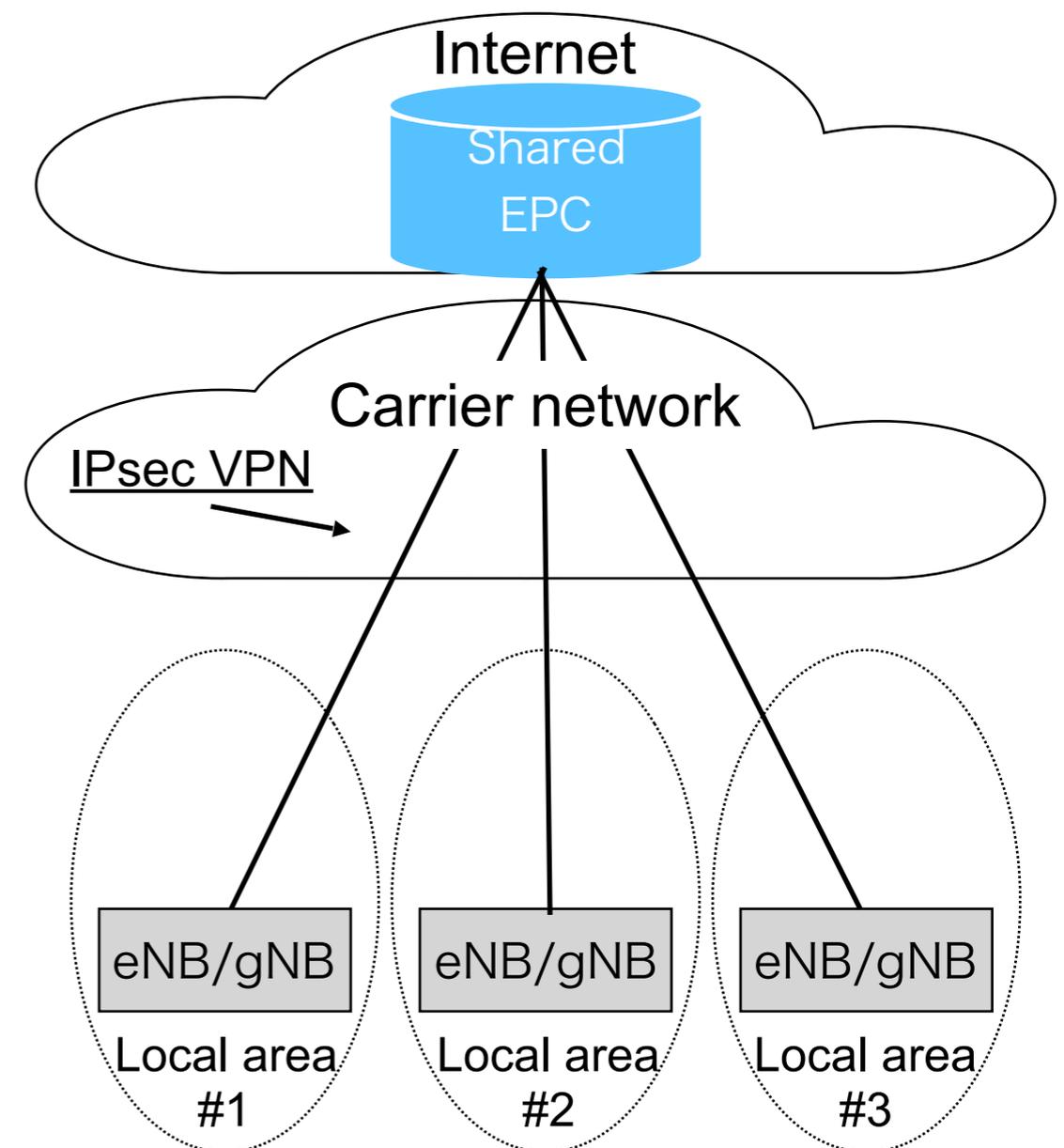
There are two types of the architecture.

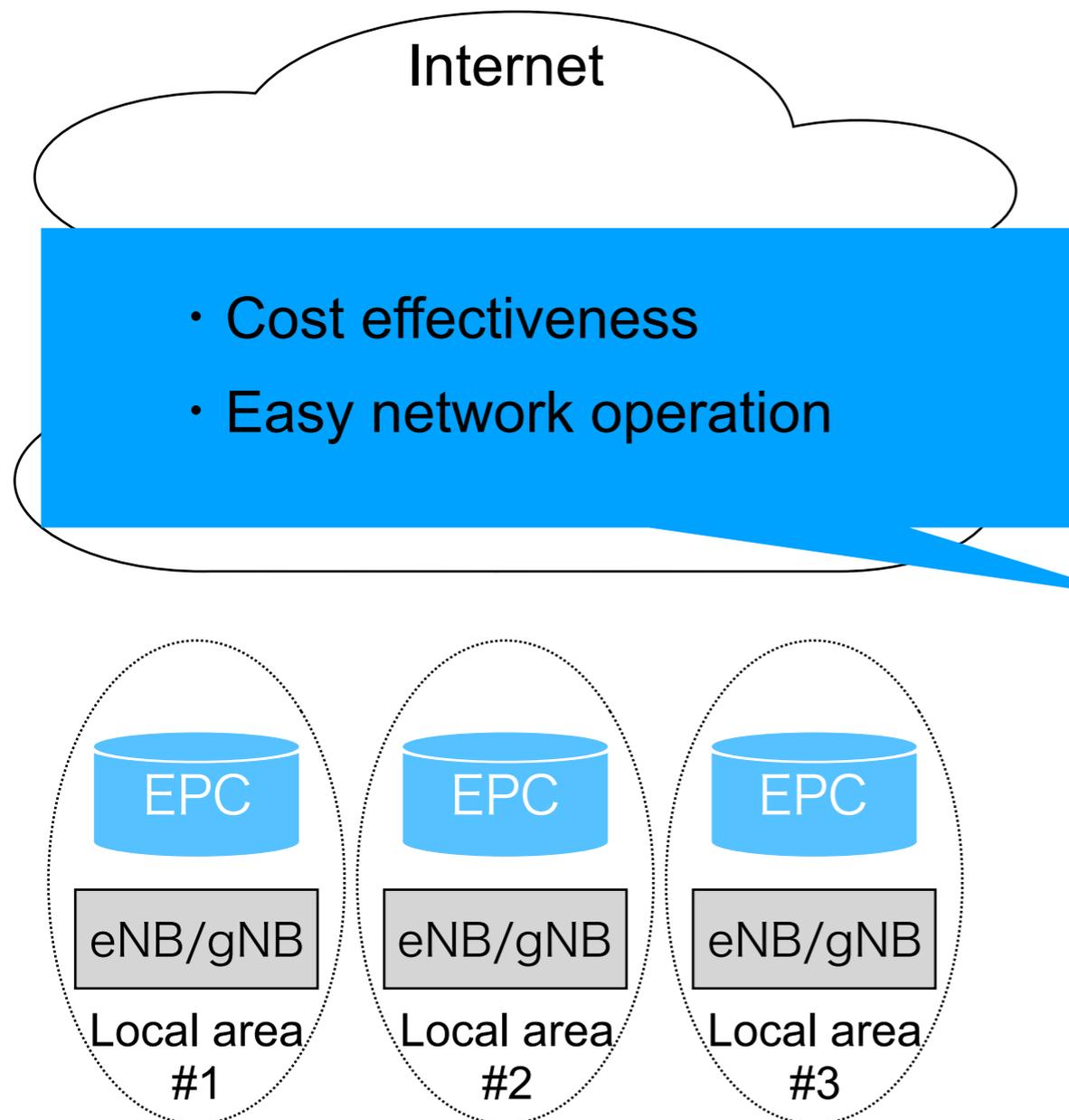| **On-premise**	**Cloud**
Whole system in user's local area	Shared system based on a cloud

Local 5G network architecture

There are two types of the architecture.

On-premise
Whole system in user's local area

Internet

・Cost effectiveness
・Easy network operation

EPC   EPC   EPC

eNB/gNB   eNB/gNB   eNB/gNB

Local area #1   Local area #2   Local area #3

Cloud
Shared system based on a cloud

Internet

Shared EPC

Carrier network

IPsec VPN

eNB/gNB   eNB/gNB   eNB/gNB

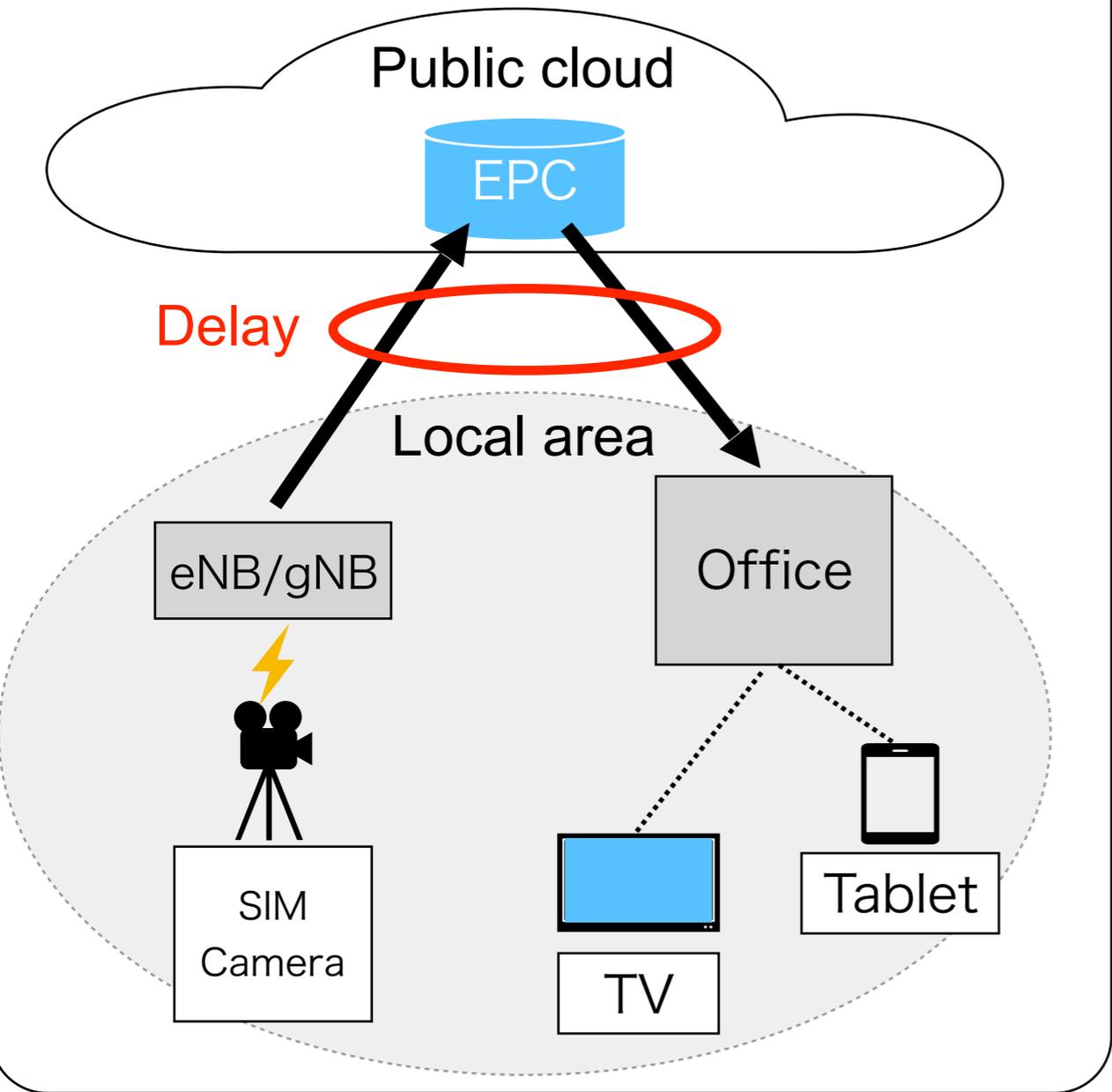Local area #1   Local area #2   Local area #3

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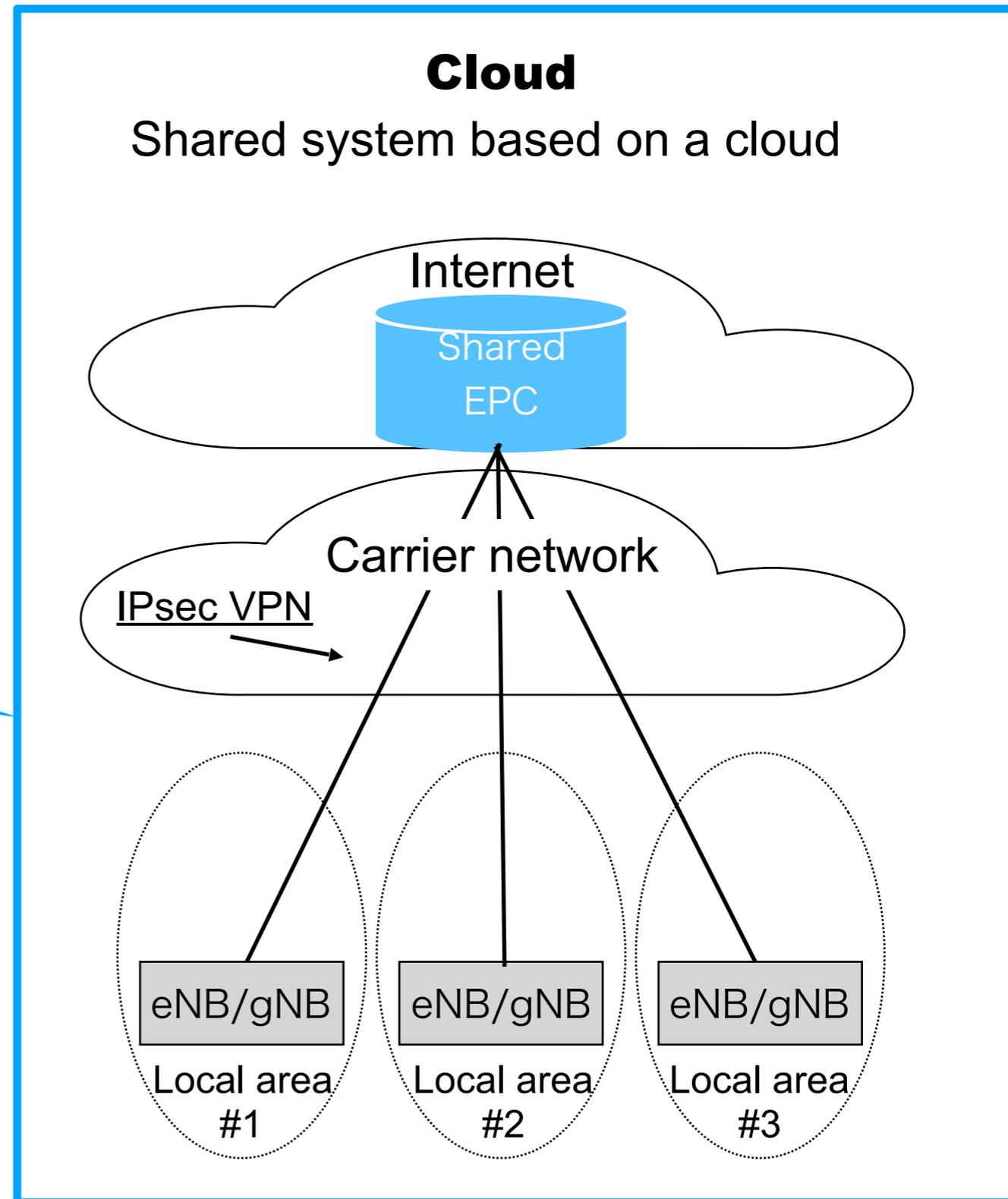
Existing problems in the cloud architecture

Using a public cloud, problems are existing in some use cases.

1. Low latency service
e.g. Live streaming, autonomous cars

Public cloud

EPC

Delay

Local area

eNB/gNB

Office

SIM Camera

TV

Tablet

2. Data confidentiality service
e.g. Industrial automation, government NW

Public cloud

EPC

Breaking confidentiality

Local area

eNB/gNB

App

Sensor

Info A

Sensor

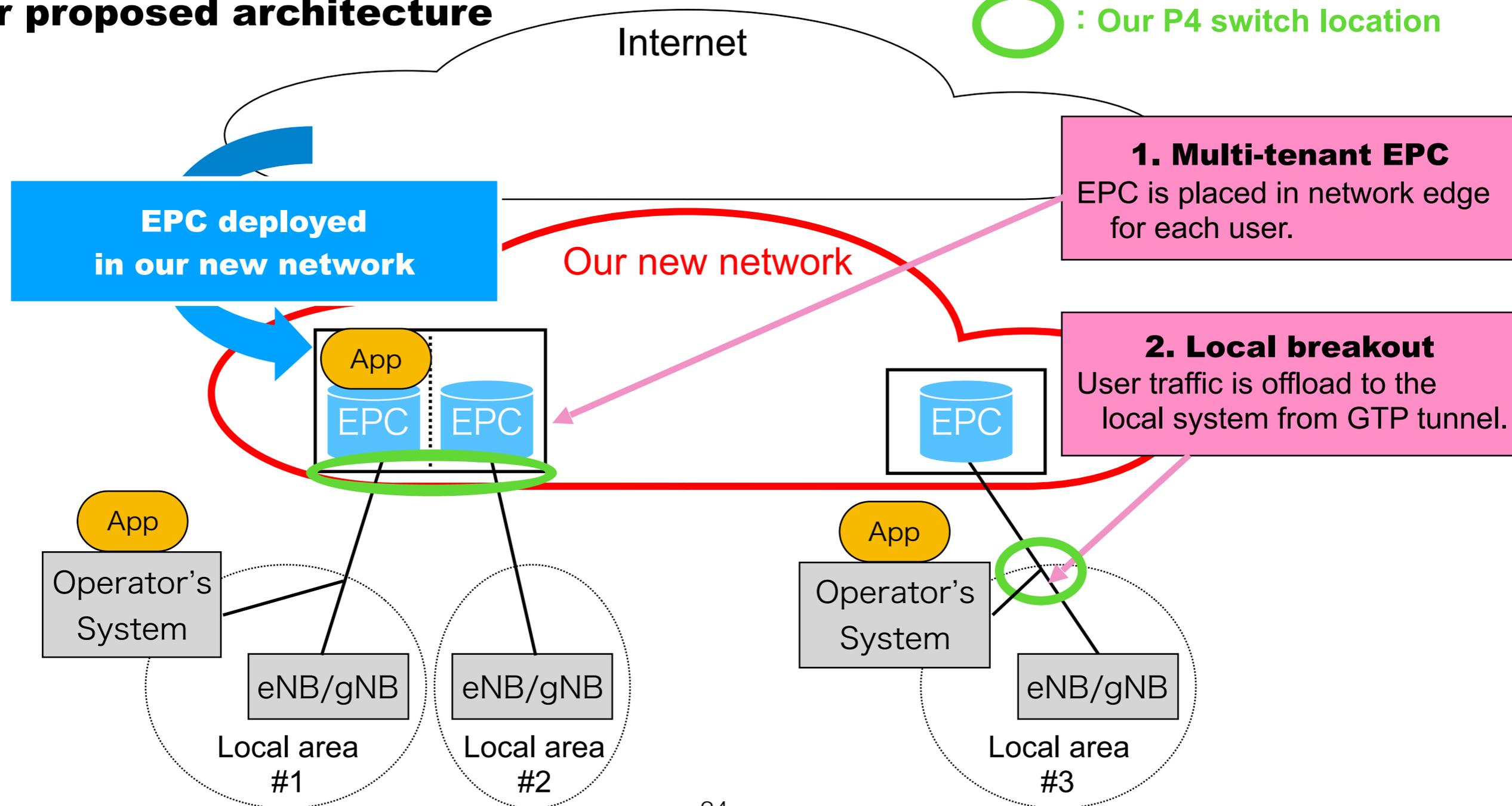Info B

User's System

Info A

Info B
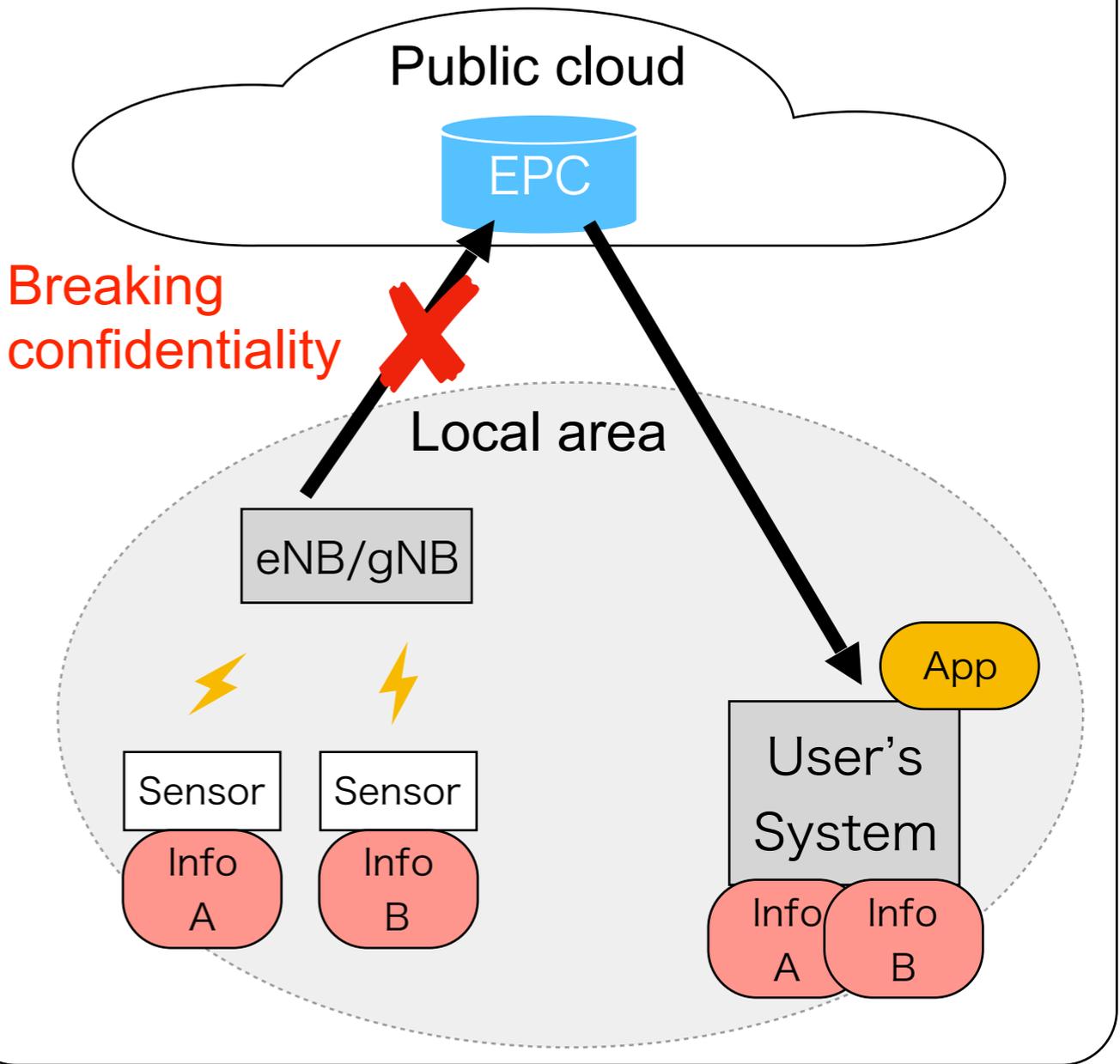
New architecture with P4

- This architecture we proposed has two features:
  - Multi-tenant EPC using P4-offloaded S/P GW in network edge
  - Local breakout to a MEC server by P4 packet broker
- **Basic implementation is done!**

Our proposed architecture

Internet

⬭ : **Our P4 switch location**

EPC deployed in our new network

Our new network

1. Multi-tenant EPC
EPC is placed in network edge for each user.

2. Local breakout
User traffic is offload to the local system from GTP tunnel.

App

EPC EPC

EPC

App

Operator's System

App

Operator's System

eNB/gNB

eNB/gNB

eNB/gNB

Local area #1

Local area #2

Local area #3

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Conclusion

■Evaluate the P4 use cases

(1)Streaming Video :
Deployed the streaming function on P4 Switch.
Visibly checked streaming function works well.

(2)Switching functions:
We were able to switch the functions in 30 msec.

■New use cases of P4

Local 5G architecture with P4 as a use case

- Evaluation timeline (TBD)

	2019		2020			
	Jul.	Oct.	Jan.	Apr.	July	Oct.

Evaluate P4 Use cases
➢ Live streaming
➢ Switching Functions

Evaluate Local 5G Use cases
➢ Multi-tenant EPC used P4-offloaded S/P GW
➢ Local breakout by P4 packet broker

Thank you